On the Observation of Magnetic Viscosity of Ferrites at Low Temperatures

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Fig. 1

Figure 1: Fig. 1

Fig. 2

Figure 2: Fig. 2

Abstract

Full Text

Physics

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On the Observation of Magnetic Viscosity of Ferrites at Low Temperatures

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When the temperature is lowered, the magnetic viscosity of most ferromagnets, in particular ferrites, increases strongly ([1],[2]). This increase in viscosity can be observed by a very simple method. On a toroidal ferrite specimen with high initial permeability (_0 2000) gauss/oersted, two windings are placed: a primary magnetizing winding and a secondary measuring winding; the voltage from the secondary winding, through a tube integrator or an ordinary integrating RC circuit and amplifier, is fed to the vertical input of an oscilloscope.

Fig. 1

Fig. 2

The sweep voltage is fed to the oscilloscope in the usual way from a resistor connected in series with the magnetizing winding of the toroid ([3]). A low-frequency current, for example 50 Hz, is passed through the magnetizing winding. The current amplitude is chosen so that the ferrite is in the field (H'), at which the static magnetization curves taken at room temperature and at the temperature of liquid nitrogen intersect (Fig. 1). Then the values of the static magnetic permeability at these two temperatures are the same, and a decrease in the induction (B) at sufficiently low frequencies and low temperatures can be caused only by magnetic viscosity.

Figure 2 shows oscillograms of hysteresis loops of a ferrite with (_0 = 2000) at temperatures of (293^ K) (the narrow high loop) and (78^ K) (the broad low loop). As can be seen, the decrease in induction due to viscosity reaches a very significant magnitude, which must be taken into account when designing ferrite apparatus intended to operate at very low temperatures.

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References

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2. E. F. Kuritsyna, *Dokl. Akad. Nauk SSSR*, **84**, No. 1, 45 (1952).

3. G. Gund, *Measurements at High Frequency*, 1931.

Note: Figure translations are in progress. See original paper for figures.